AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY 100:605–608 (1996)

Technical Note

Construction and Use of an Inexpensive "Anthropometer"

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KEY WORDS Student projects, Posture, Anthropometer

ABSTRACT An inexpensive anthropometer, suitable for use in undergraduate projects, was constructed from aluminum rod and components designed from laboratory retort stands. Only modest workshop skills and widely available machine tools were required to produce the device, which could be used to take accurate and reproducible measurements of linear dimensions and the angles of orientation of body segments. Its use in student projects indicates the value of the angular measurements in investigating posture.

Anthropometers are widely used for taking measurements of various body dimensions. Commercially available models are well engineered to permit accurate and reproducible measurements. However, the care taken in their manufacture is reflected in their cost and consequently these models may not be available to all workers.

Several "inexpensive," and therefore in theory more readily available, measuring devices have been detailed in the literature. These include stadiometers described by the United Nations Department of Technical Co-Operation for Development and Statistical Office (1986), and anthropometers designed to measure projected lengths (Ross, 1984). Some "low cost" devices are, however, only relatively inexpensive, having designs likely to require fairly advanced workshop skills to construct (e.g., Davies and Moustafa, 1986).

Short-term, student-led research projects investigating relationships between physical activities and posture required a portable method of measuring various body dimensions and parameters such as the angle between body segments. The financial resources allocated to the projects were sufficiently restricted that a new, genuinely low cost device had to be designed and constructed "in house."

The new device was designed with the following requirements: (1) construction materials and components should be inexpensive and readily available, yet light and robust (student proof!); (2) construction should be quick and easy, given generally available workshop facilities and modest machine shop skills; and (3) the device should be easy to use, providing accurate and reproducible measurements of linear dimensions and angles between points on the body.

CONSTRUCTION

The device developed to meet the above requirements is shown in its component parts in Figure 1, and is shown in use in Figures 2 and 3. Constructed from half-inch diameter aluminum rod, the arms and the main column along which they are moved are light and strong. The clamps which hold the arms are designed for laboratory retort stands (Merck Ltd, Lutterworth, UK) and are of a robust construction. An extension column constructed from aluminum rod and a retort stand base to hold the column vertical facilitate the use of the device to measure heights (Fig. 2).

Received August 28, 1995; accepted February 25, 1996.

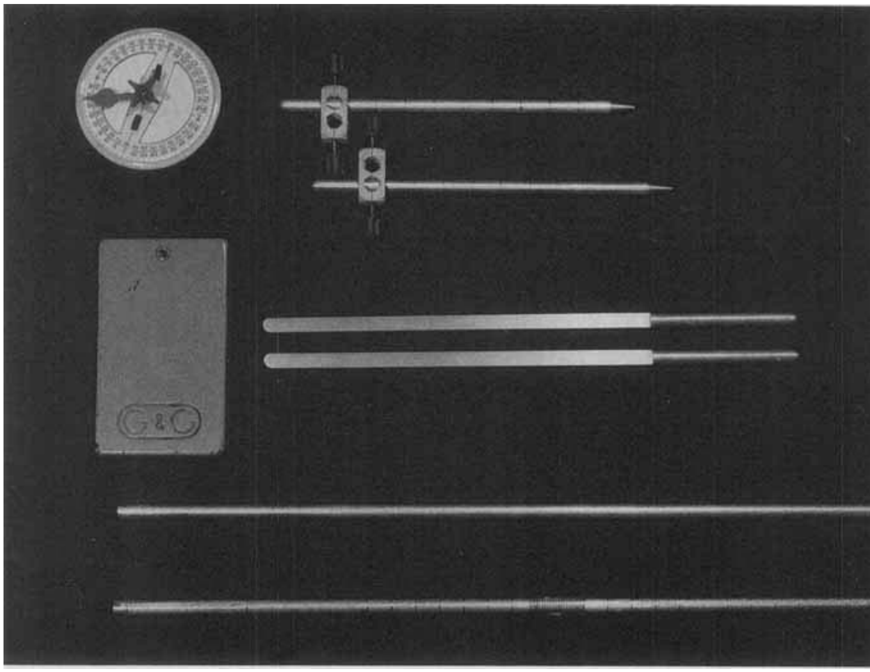

Fig. 1. The component parts of the device (from left to right, top to bottom of figure): protractor with plumb; pair of arms, pointed at one end and rounded at the other, shown with clamps attached; base (an old retort stand base scavenged from a laboratory) threaded to accept the extension column; pair of flat edged arms; extension column (passing out of figure on right) threaded to accept main column; main column (passing out of figure on right) with circumferential marks at 2 cm intervals, and plastic cursor with markings every 2 mm.

Several sets of arms were machined for different uses. Guide holes drilled in the arms and a groove milled along the main column provide a means of orientating the arms.

It was intended that the device should be capable of measuring linear dimensions to the nearest millimeter. However, it was judged too time consuming to mark accurately and indelibly the central column at the 2 mm intervals required for this precision. Instead, circumferential marks were made on the main column every 2 cm using a lathe, and a clear plastic cursor marked in 2 mm divisions fitted over the column. This cursor, used in conjunction with the 2 cm markings on the column, allows distances to be determined to the nearest millimeter.

A protractor and weighted plumb can be attached to the main column via a universal coupling (also designed for retort stands) so that the angle of the column relative to a line perpendicular to the ground can be measured. These measurements, made while the tips of the arms are in contact with two points on the subject's body, gives a measure of the angle between the points (Fig. 3).

The device took just over a day to construct using a milling machine and lathe. Materials for its construction cost about $65.

EVALUATION

The projects for which the device was originally built were to investigate whether the "natural," relaxed posture of subjects varied with the nature of their employment or sporting activities. Measurements taken from subjects asked to assume a "military" upright stance were compared to measurements obtained while the subjects were standing in their usual relaxed posture, to determine whether differences between

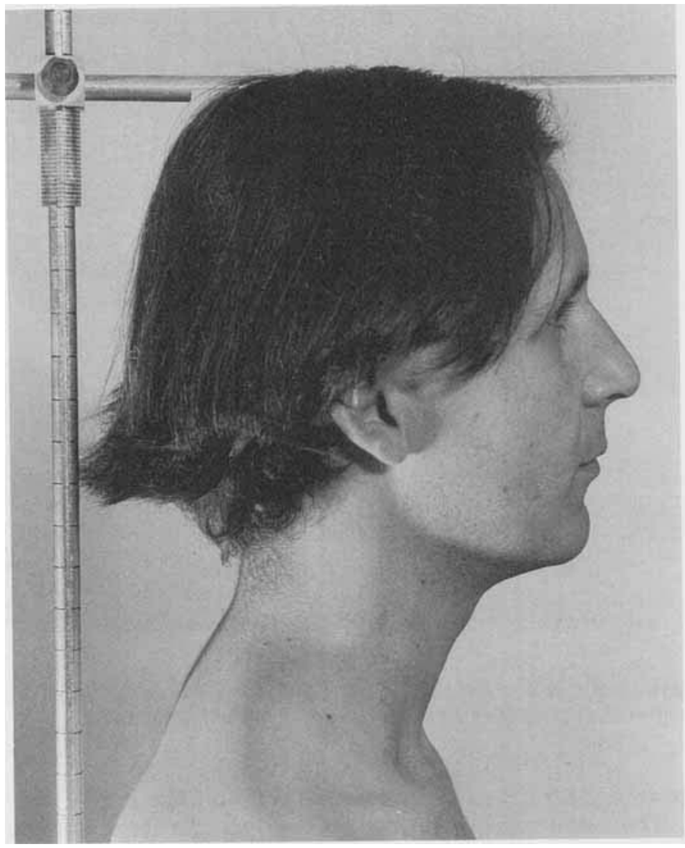

Fig. 2. The device being used to measure height. The central column is attached to the extension rod and base (not shown in figure). Note the groove extending the length of the column which in conjunction with the clamp screw allows the arm to be orientated. Note also the plastic cursor used to give 1 mm resolution to measurements.

these two sets of measurements could be related to the subjects' sporting or employment activities.

In addition to conventional linear measurements such as stature (Fig. 2), angles such as the "shoulder angle"—the angle between the line joining the acromial processes and the perpendicular (Fig. 3); and the "back angle"—the angle between the line joining the seventh cervical vertebra and the coccyx, and the perpendicular; were measured.

Measurements taken using the device were shown to be reproducible; for example, stature measurements performed as recommended by Gordon et al. (1988) had a standard deviation of 0.6 mm. Measurements of "shoulder angle" had a standard deviation of 0.8°.

In the student projects, angular measurements appeared particularly useful for characterizing posture. For example, with increasing age "natural" back angle was shown to increasingly deviate from "military" back angle (Rees, 1994) and the shoulder angle of runners but not of swimmers was less horizontal with age (Hindle, 1994).

CONCLUSION

Though inelegant, the device was robust, easily constructed, and inexpensive. Measurements taken with the device were accurate and reproducible, and the ability to

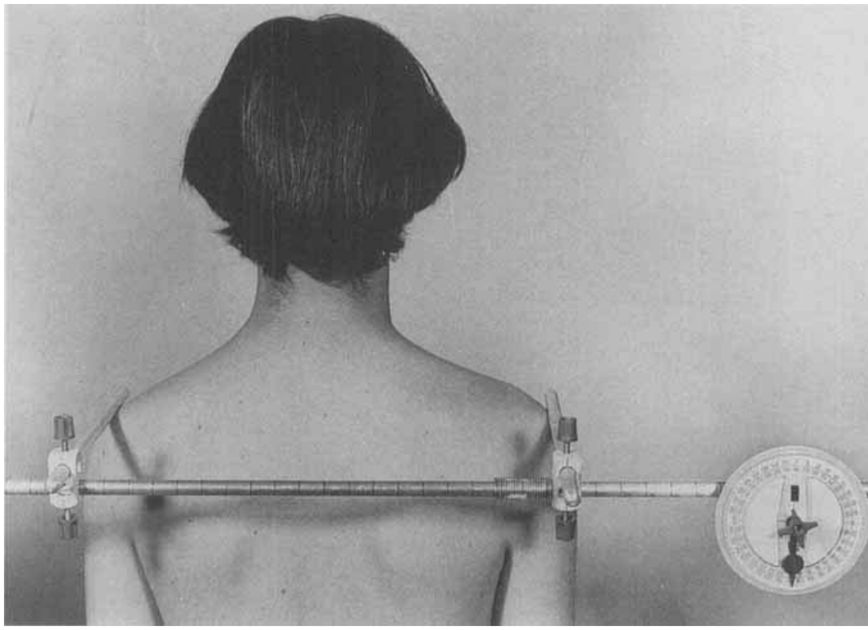

Fig. 3. The device being used to measure biacromial diameter and the "shoulder angle." The arms of the device are orientated parallel by use of the groove shown in Figure 2.

measure angles proved useful in a number of short projects. The aluminum rod from which the device was constructed, or effective substitutes, are readily available. The machinery required to work the rod is present in most machine shops including those in many schools instructing in craft and design. The more intricate components are available through laboratory catalogs.

The low cost and speed of constructing this device may make it an acceptable substitute for commercial anthropometers in some circumstances; in particular this device may find use in schools and colleges to introduce students to various aspects of anthropometry.

ACKNOWLEDGMENTS

I thank Mr. Bernard Tilley for his assistance in constructing the anthropometer; Miss Annali Hindle and Miss Linda Rees for feedback on the use of the device and Mr. Emyr Pritchard and Mr. Simeon Walker for assistance with photography.

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